REMARKS

Applicants respectfully request reconsideration of the application, as amended, in view of the following remarks.

The claims have been amended and new Claims 29-35 have been added as supported by the claims and specification as originally filed, for example at page 14, 3rd full paragraph, tables 2 and 3.

No new matter is believed to have been added by entry of this amendment. Entry and favorable reconsideration are respectfully requested.

Upon entry of this amendment Claims 1, 3, 5-13 and 22-35 will now be active in this application.

The rejection of claims 22-27 as being indefinite is traversed in view of the specification at page 14, 3rd full paragraph which states:

"The foams have an extremely fine pore structure and therefore extremely low resin absorption (Table 3)" Thus, "extremely fine" is defined in the specification.

Applicants also wish to draw the Examiner's attention to claims 29-31 in which the pore size is further defined.

Thus, this rejection should be withdrawn.

The present invention as set forth in **Claim 1** relates to a process for producing a foamable crosslinked polymer, comprising:

polymerizing a mixture comprising

(A) 30-70 parts by weight of methacrylic acid,

30-60 parts by weight of methacrylonitrile,

0-30 parts by weight of other monomers having vinyl unsaturation,

(B) **0.01-4.99 parts by weight of tert-butyl methacrylate,**

(C) 0.01-10 parts by weight of blowing agent,

(D) 0.01-10 parts by weight of crosslinking agent,

(E) 0.01 to 2 parts by weight of a polymerization initiator, and

(F) 0 to 20 parts by weight of a conventional additive,

in bulk to give a polymer in the form of a sheet;

wherein said sheet is optionally subjected to the following treatment:

heat-conditioning and then foaming at temperatures of from 150 to 250°C.

Claim 3 relates to a foamable crosslinked polymer, comprising in polymerized form:

(A) 30-70 parts by weight of methacrylic acid,

30-60 parts by weight of methacrylonitrile,

0-30 parts by weight of other monomers having vinyl unsaturation,

(B) **0.01-4.99 parts by weight of tert-butyl methacrylate,**

(C) 0.01-10 parts by weight of blowing agent,

(D) 0.01-10 parts by weight of crosslinking agent,

(E) 0.01 to 2 parts by weight of a polymerization initiator, and

(F) 0 to 20 parts by weight of a conventional additive.

New Claim 30 relates to a process for producing a foamable crosslinked polymer, comprising:

polymerizing a mixture comprising

(A) 30-70 parts by weight of methacrylic acid,

30-60 parts by weight of methacrylonitrile,

0-30 parts by weight of other monomers having vinyl unsaturation,

(B) 0.01-4.99 parts by weight of tert-butyl methacrylate,

(C) 0.01-10 parts by weight of blowing agent,

(D) 0.01-10 parts by weight of crosslinking agent,

(E) 0.01 to 2 parts by weight of a polymerization initiator, and

(F) 0 to 20 parts by weight of a conventional additive,

in bulk to give a polymer in the form of a sheet;

wherein said sheet is subjected to the following treatment:

heat-conditioning and then foaming at temperatures of from 150 to 250°C to obtain a foam having extremely fine and uniform pore structure having a pore size of 5-35 μm.

New Claim 31 relates to a foamable crosslinked polymer, comprising in polymerized form:

(A) 30-70 parts by weight of methacrylic acid,

30-60 parts by weight of methacrylonitrile,

0-30 parts by weight of other monomers having vinyl unsaturation,

(B) 0.01-4.99 parts by weight of tert-butyl methacrylate,

(C) 0.01-10 parts by weight of blowing agent,

(D) 0.01-10 parts by weight of crosslinking agent,

(E) 0.01 to 2 parts by weight of a polymerization initiator, and

(F) 0 to 20 parts by weight of a conventional additive;

wherein when said polymer is subjected to heat-conditioning and then foaming at temperatures of from 150 to 250°C, a foam having extremely fine and uniform pore structure having a pore size of 5-35 μm is obtained.

In **new claims Claim 32-35**, **(B) is 1 to 2 parts by weight of tert-butyl methacrylate**. ***See also examples B1 and B2 of the Rule 132 Declaration.***

Geyer does not disclose the use of t-butyl (meth)acrylate. Krieg does not disclose the use of t-butyl (meth)acrylate. Tada discloses the use of large amounts of 5 to 50% the weight of t-butyl (meth)acrylate.

In addition, Geyer, Krieg and Tada do not disclose or suggest **a foam having extremely fine and uniform pore structure having a pore size of 5-35 µm** ***as claimed in claims 29, 30 and 31. Tada in particular is applicable for the production of foams with large and unsteady pores. This is different from the claimed extremely fine and uniform pore structure in which the pores have a pore size of 5-35 µm.***

Applicants previously provided a Rule 132 Declaration showing that the use of the claimed amount of t-BuMA gives superior results compared to higher amounts used.

Examples B1 and B2 according to the present invention were prepared. In addition, Comparative Example A1 was prepared.

The polymers of A1 and B1 were foamed in a convection oven for 1h at 200 °C and for additional 2h at 220 °C.

The composition of B2 was foamed in two different ways (first and second foaming program) under the conditions given in table 3.

Table 1

Example	MAA	MAN	tBMA	tert-BuOH	AMA

	pbw	pbw	pbw	pbw	pbw
A1	44.0	50.0	10.0	2.0	0.170
B1	50.0	50.0	1.0	7.5	0.170
B2	49.0	50.0	2.0	7.0	0.100

Examples B1 and B2 (first foaming program) show increased mechanical properties (compressive strength or heat resistance) having amounts of tert-butyl methacrylate in the range of Claim 1 of the present invention (0.01 to 4.99 parts by weight) compared to Comparative Example A1 with a very high amount of tert-butyl methacrylate (10 % by wt). All examples are in such a manner formulated and foamed that the materials show comparative densities.

Table 2: Mechanical properties

Example	Density [kg/m^3]	Compressive strength [MPa]	Heat resistance [°C]	Creep [%] (compression at 0,2N/mm^2, 125°C, 2h)
A1	67,75	1,807	212 / 220 / 214 / 215 (1 + 2 twice foamed 3 + 4 deformed)	0,05 (65,3 kg/m^3)
B1	69,05	2,130	224 / 230 / 229 / 226 all samples twice foamed	-0,15 (65,9 kg/m^3)

Table 3

	B2	
Foaming temperatures	1h 200° 2h 220°	1h 200 ° 2h 229°
Density [kg/m³]	64,84	49,16
Compressive strength [MPa] at 180°C	0,82	0,53

In addition, Applicants wish to draw the Examiner's attention to the data provided in the specification of the application. The same are reproduced in part from pages 14-17 of the specification:

Examples

Inventive Examples 1-7:

Table 2: Composition, foaming conditions, density and pore size of foam specimens 1-7.

Example	MAA pbw	MAN pbw	tBMA pbw	tert-Bu OH pbw	Foaming °C/h	Density kg/m^3	
1	50.0	50.0	0.0	8.0	220/2	61	
2	50.0	50.0	1.0	7.5	220/2	69	
3	49.0	50.0	2.0	7.0	200/2	75	
4	47.0	50.0	4.0	6.0	200/2	77	
5	46.0	50.0	6.0	1.5	230/2	81	
6	44.0	50.0	10.0	2.0	230/2	57	
7 a)	39.7	40.3	20.0	0	200/2	75	

a) Very brittle foam, difficult to machine

The pore sizes in Table 2 clearly show that substitution of tert-BuOH by tBMA can make the pore structure considerably finer. It appears that tBMA operates simultaneously as blowing agent and nucleating agent.

Comparative Example 8 (insoluble nucleating agents)

The resultant foam had an envelope density of 77 kg/m^3.

Comparative Example 9 (no nucleating agent)

The procedure was as described in Comparative Example 8 except that no nucleating agent was used. The resultant foam had an envelope density of 77 kg/m^3.

Table 3: Pore size and resin absorption of selected specimens compared

Example	Foam density kg/m^3	Pore size µm	Resin absorption kg/m^2
2	69	35	<0.040 a)
8	77	100-200	0.061
9	77	Not determined	0.287

a) not measurable

Table 4: Mechanical data

Example	Density kg/m^3	Compressive strength a) MPa	Heat resistance b) °C	Creep c) %
2	69	2.1	224	-0.15
6	68	1.8	215	0.05
7	66	1.8	210	0.57
8	67	1.5	Not determined	0.3

a) DIN 53452
b) DIN 53424
c) DIN 53425, ASTM D621 and D2990: 180°C, 2 h, 0.35 MPa

Geyer does not disclose the use of t-butyl (meth)acrylate. Krieg does not disclose the use of t-butyl (meth)acrylate. Tada discloses the use of large amounts of 5 to 50% the weight of t-butyl (meth)acrylate.

In addition, Geyer, Krieg and Tada do not disclose or suggest **a foam having extremely fine and uniform pore structure having a pore size of 5-35 µm** ***as claimed in claims 29, 30 and 31. Tada in particular is applicable for the production of foams with large and unsteady pores. This is different from the claimed extremely fine and uniform pore structure in which the pores have a pore size of 5-35 µm.***

Geyer discloses polymethacrylimide foam materials which do not comprise tert-butyl methacrylate which however is an essential component in the polymer of the present application. Furthermore, Geyer wanted to the synthesize foams with low density and improved thermo-mechanical properties. A method for the improvement of size and shape of the pores is not disclosed in Geyer.

Krieg discloses a polymethacrylimide foam but fails to disclose the use of tert-butyl methacrylate which however is an essential component in the polymer of the present application.

Tada discloses materials which comprise tert-butyl methacrylate (t-BuMA) in amounts from 5 to 50 wt% of the total components. The method of Tada is only applicable for the production of foams with large and unsteady pores.

The present application uses a much smaller proportion of t-BuMA. One object of the present application was the development of fine-pore (small pore size) PMI foams. This is achieved without the use of insoluble nucleating agents like magnesium oxide (corresponding to Geyer). See new Claims 20 and 21 which exclude the use of insoluble nucleating agents explicitly.

Another object were good thermo-mechanical properties (such as heat resistance), as compared to conventional polymethacrylimide foams. This is achieved by the present invention and not suggested by the cited references, alone or in combination.

The examples according to the present invention in view of comparative examples 7 and 8 show that superior mechanical properties in combination with small pore sizes were obtained when the amount of TBMA is within the claimed range.

The examples also show that an increasing amount of t-BuMA and a decreasing amount of t-BuOH results in foams with smaller pores. Amounts of more than 5.0 wt% (as in

Tada) give foams with very small and obviously mean mechanical properties (such as a high brittleness).

Col. 4 of Geyer which discloses generally the use of esters of methacrylic acid of C1-4 alcohols up to 20 wt%. However, the specific use of t-bu-methacrylate is not mentioned or exemplified. The 7th Example from the top of table 1 of Tada uses 10 parts of TBMA. It would NOT have been obvious to use 4.99 parts of TBMA in Geyer. Applicants refer to the above-mentioned disclosure at page 9 which mentions superior thermo-mechanical properties. Table 4 also provides mechanical properties.

Further, in Claims 14 and 15, there is no TBA in component (B).

Tada et al, Stein, Wu, Zacharopoulus, Nieuwendijk and Baumann do not cure the defects of Geyer et al or Krieg et al.

Therefore, the rejection of the claims under 35 U.S.C. § 103(a) over Geyer et al or Krieg et al in view of Tada et al, Stein, Wu, Zacharopoulus, Nieuwendijk and Baumann are believed to be unsustainable as the present invention is neither anticipated nor obvious and withdrawal of this rejection is respectfully requested.

This application presents allowable subject matter, and the Examiner is kindly requested to pass it to issue. Should the Examiner have any questions regarding the claims or otherwise wish to discuss this case, he is kindly invited to contact Applicants' below-signed representative, who would be happy to provide any assistance deemed necessary in speeding this application to allowance.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Kirsten Grueneberg

Kirsten A. Grueneberg, Ph.D.
Registration No.: 47,297

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
KAG
(OSMMN 08/07)